Impact of Recent and Anticipated Change in Oil Price on Global Logistics and Supply Chain Activities - A Survey of Practitioner and Educator Opinions

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Abstract

Purpose: This research investigated the views of logistics and supply chain (SC) managers, and also those of educators teaching these disciplines, of the impact of the recent fall in oil price, and also anticipated future oil prices, on global logistics and SC activities. In terms of future prices, this work has sought to understand how these professionals see the oil price as evolving in the near term (3-years) and medium term (10-years), and hence understand the impacts they foresee for logistics and SC activities.

Research Approach: The research is empirical, with semi-structured questionnaires being handed out and collected at a recent industry logistic and supply chain event in the UK, at a corresponding conference in the UK, and likewise at an international conference in the US. This approach ensured that only the target audience - middle and senior managers in companies, and lecturers and above in universities - were surveyed, and that a high response rate was achieved. The questionnaire was kept short and anonymous to assist this high take-up rate. A total of 31 valid questionnaires were returned, and these were analysed using both qualitative and quantitative (SPSS) methods.

Findings and Originality: This research is recent and original. One key and perhaps surprising finding is that about half of respondents thought that the recent fall in oil price had had no significant impact on logistics and supply chain activities, while the other half thought there had been an impact, classing this as 'medium', and identifying the nature of these impacts. A second key finding was the very wide range of expectations, from both managers and educators, of the future price of oil; with estimates for the expected oil price 10 years hence ranging from below $30/bbl to over $120/bbl.

Research and Practical Impacts: The survey showed that the risk of a significant medium-term constraint to global oil supply, sufficient to raise the oil price to above $90/bbl, was thought unlikely by nearly two-thirds of those that responded to the questionnaire. In terms of research impact, it is hoped that this paper will help raise awareness of this future price risk, both for practitioners within the logistics and SC industry, and for those that teach these topics within academia.

Keywords: oil price; impact; logistics; supply chain, survey

1. Introduction

This paper is about the recent - and future - price of oil, and the impacts this has had, and will have, on logistics and supply chain activities. The paper starts by looking at the impacts resulting from the recent dramatic fall in oil price, from greater than $80/bbl for nearly all of 2007 to 2014 (and around $120/bbl for a considerable part of this period), down to a low of only around $35/bbl at the time of this research. Against this background, it is fairly straightforward for experts to comment on how this has affected the logistics and supply chain activities known to them, or about which they teach.

By contrast, the topic of anticipating the future oil price, and hence the impacts this may have, is much less clear-cut. Many consider that the apparent unreliability of past oil price forecasts indicates that the oil price is too complex to forecast usefully. In fact, this view is not well founded, and for this reason

we briefly discuss next how the oil price has changed in the past, and in particular, how people's *expectations* of this price have varied over time.

2. Literature Review

2.1. A brief historical perspective on oil price

For the half-century from 1920 to 1970 large volumes of oil were discovered globally, and as a result the price of oil fell steadily, from about $30/bbl (in current real-terms) in 1920 down to close to $10/bbl (real-terms) in 1970. This long price decline supported major increases in many forms of economic activity, including in transport associated with logistics and SC activities. But then came the first 'oil shock' in 1973, with its sharp rise in price (Figure1). When coupled with the second price shock in 1978, the view developed widely among analysts, and also the general public, that global oil supply was likely to 'run out' fairly soon; with this view perhaps being expressed most dramatically by President Carter's 'Moral Equivalent of War' speech in 1977.

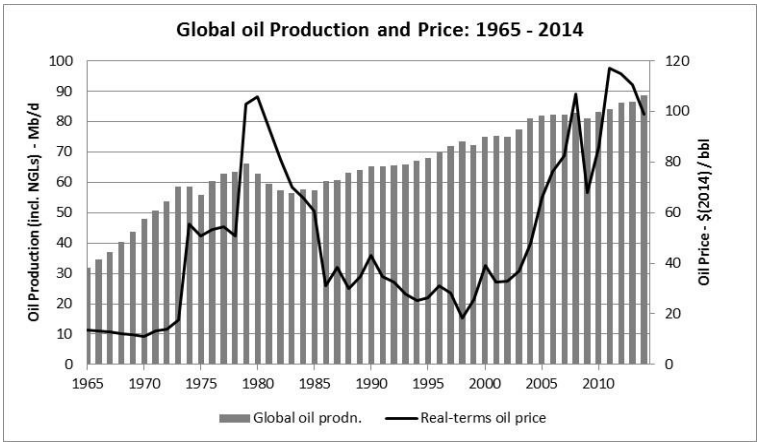

Figure 1: Global oil production, and oil price: 1965 – 2014.

Vertical bars, and left-hand scale: Global 'all-oil' production, in millions of barrels/day; Solid line, and right-hand scale: Annual-average real-terms oil price, in 2014$/bbl; Source: BP *Statistical Review 2015*; based on an original plot by E. Mearns

However, a price shock around 1970 had in fact long been correctly anticipated by those analysts that used 'resource-based' oil forecast models for the US. These showed that the US would reach its peak of *conventional* oil production between about 1965 and 1970; and since the US was then the major oil supplier outside of OPEC, short-term global supply constraints were to be expected. Moreover, the general view in the late-70s, early-80s that global oil would 'run out' soon was itself at variance with 'resource-based' oil forecast models for the world as a whole, which showed that enough oil had been discovered *globally* for total conventional oil production to continue to increase rapidly up until around the year 2000, before only then starting to decline.

The global 'resource-based' models were indeed correct, and after the 1970s price shocks large volumes of new oil came on-stream from already discovered provinces, including Alaska, the North Sea and elsewhere. In face of this new supply, OPEC initially cut production to maintain price, but with Saudi Arabia taking the bulk of these cuts, in about 1985 the latter gave up the game, and the price of oil fell dramatically.

Unfortunately, on the basis of this new - and sustained - low price for oil after 1985, and hence the realisation that the widely-accepted 'oil running out' view had not been correct, the majority of analysts instead switched dramatically to an 'oil cornucopia' view, driven by the concept that reserves data were not be trusted, and were simply inventory that could be replaced as needed. Despite the continued warnings from the global 'resource-based' models that supply difficulties of total conventional oil production were to be expected from about the year 2000, this 'cornucopia' view

dominated, and thus the rapid rise in oil price after 2003 (back to the 1978 real-terms levels of $100/bbl and above) came as a shock to most; where a widely cited reason for this rise in price was increased demand for oil, particularly in Asia, rather than from constraints on global conventional oil supply.

This is an important narrative, and is given here as background to the future oil price expectations presented below. For a more detailed discussion of these shifts in oil price over time, and in the public expectations, see Bentley & Bentley (2015a and b), Bentley (2016), and Inman (2016).

2.2. Impact of oil price on global logistics/SC activities

Now we turn to the impact of oil price on global logistics and SC activities. It seems natural to expect this price to have a significant impact on such activities, where a high oil price adds directly to the fuel bills of the transport involved, and also adds to most other costs by way of the embedded fuel costs of nearly all activities; for example, in the oil used for transport and heating when constructing the vehicle fleet, or for building and maintaining roads (where the later oil costs are paid in part via vehicle taxes).

But though general reference is often made to this linkage with oil price, we have found surprisingly few studies that have looked at this linkage in any analytical or quantitative way. One, for example, is Ronen (2011) on the effect of oil price on containership speed and fleet size; while among more broadly-based studies is that by Christopher and Holweg (2011). In terms of supply chain management (SCM), the latter authors point out (p63) that '*an underlying principle is to establish control of the end-to-end process in order to create a seamless flow of goods*', and that '*variability is detrimental to performance*'. The authors go on argue that *'in the light of increasing turbulence* [which in their publication includes oil price shocks, as well a global recessions] *a different approach to SCM is needed'.* Their work shows that *'most current SCM models emanate from a period of relative stability'* and that '*there is considerable evidence that we will experience increasing turbulence in the future*'. Their work raises the question whether current SC models will be able to meet the challenges of this increased turbulence.

But, as we note, overall there appears to be relatively little literature examining the oil price / logistics and SC linkage in any quantitative manner, suggesting an avenue for useful research.

3. Research Objectives

The aim of the research described here has been to examine one aspect of this topic; and specifically to understand the opinions of logistics and supply chain managers, and of educators teaching these disciplines, of this linkage. In particular, the aim has been to understand how these professionals see (a) the recent oil price fall, and (b) their view of how the oil price is likely to evolve over the near and medium term, in terms of their impact on logistics and SC activities; and hence also on how this is likely to affect future decisions in these disciplines.

In addition, the motive for this research has been driven by the following considerations:

- The impact of oil price on logistics and supply chain activities is likely to be a function of time-horizon. For example, a high fuel cost is likely to reduce profitability in the short term, but over the longer term is likely to encourage adoption of more efficient vehicles, their more efficient use (such as 'reverse logistics'), and fuel switching (for example, to compressed natural gas).
- The period of high oil price from 2007 to 2014 placed stress on many economic activities, including on logistics and supply chains, and led to discussion of 'peak oil' (Bentley, 2016).
- But then the recent low price (below 40/bbl) caused many to reappraise this view, and has required logistics and supply chain managers, and also educators in these fields, to reflect more deeply about what oil supply situation to expect going forward. The research carried out here has been aimed at gaining an understanding of this new thinking.

4. Research Methodology

This research is empirical, with semi-structured questionnaires having being handed out and collected on three occasions from February to April, 2016; i.e., when the oil price was around its recent lowest, in the range, roughly, from $30 to $40/bbl. The occasions were an industry logistic and supply chain event in the UK, a conference also in the UK, and an international conference in the US. This thus represented the 'key informant' approach to collecting data, where respondents are chosen because they have specialized knowledge of the topic being surveyed; here, of logistics and supply chain management (Bagozzi, et al. 1991). Using this approach, the answers to the survey questions, and the additional comments provided, are seen as providing relevant and useful insight.

Moreover, this 'hand-out-and-collect' method for distributing the questionnaires ensures a high response rate, and that only the target audiences (in this case, middle and senior managers in companies, and lecturers and above in universities) are surveyed. The questionnaire itself was designed to be short (10 questions) and kept anonymous to help this high take-up rate. It included a number of 'open-ended' questions, as well as space for wider comments, to allow respondents to amplify their views.

The questionnaire was given to suitable respondents by the lead author (Y. Bentley) at the following events:

- CILT (UK) event: DHL's Airline Catering Services, Heathrow Airport, London (09 Feb. 2016).
- CILT (UK) Logistics Conference: Smart Logistics and Transport, London (24 Feb. 2016).
- The International Conference on Business and Economic Development, New York (4-5 Apr. 2016).

A total of 31 valid questionnaires were returned and analysed. Statistical analysis by one of the authors (G. Cao) used SPSS. Note that given the relatively small sample size, the validity of the results below rests primarily on the experience level of the respondents, the fact that they were met by the lead researcher at professional gatherings, and the thoughtfulness of their replies, rather than on statistical significance tests (as would be appropriate for judging the validity of, for example, an 'arms-length' large-scale survey).

5. Research Findings

This section summarises the research findings, and follows the sequence of survey questions.

5.1. Respondent breakdown

Questions 1 to 3 asked about the category of organisation of the respondent, this organisation's size, and the respondent's role within the organisation. About half the respondents were logistics and supply chain practitioners in industry and half were academics teaching these disciplines, in line with the research design goals.

Of those from industry and related sectors, some 20% said they represented providers of third party logistics (3PLs), another 10% were business consultants, and just over 6% in each case said they were from manufacturers and government departments, respectively. The remaining about 50% identified themselves as being from a variety of other sectors. In terms of organisation size, about two-thirds of all respondents (industry and related, plus academic) were from large organizations (having more than 250 employees), 20% were from medium-sized organizations (between 10 and 250 employees), and 13% were from micro-organizations having less than 10 employees.

The reported positions of the respondents within these organisations suggested that about 45% were in a senior managerial positions in companies, while the rest identified themselves as mainly being lecturers, senior lecturers, professors, or other academic position holders. Overall, the sample of respondents was adequately diverse, fitted the profiles that had been anticipated, and gave

confidence that though the sample size was relatively small, their responses were likely to yield useful information given the levels of respondent expertise.

5.2. Impact of the recent fall in oil price

Questions 4 to 7 focussed on the recent fall in oil price, i.e., from > $80/bbl for most of the period from 2007 up to 2014, down to ~$35/bbl at the time of the surveys. The questions asked whether this fall had had an impact on the logistics and supply chain activities of their organisation; if so whether this impact was minor, medium or large, and to list specific impacts.

Interestingly, the perception of the impact of the recent fall in oil price on logistics and supply chain activities was polarized: half of respondents believed there had been no impact, while the other half believed there had been. Of the latter respondents, nearly 80% considered that this impact had been 'medium', rather than 'minor' (about 4%) or 'large' (about 15%).

When asked about specific logistics and supply chain activities affected by the recent fall in oil price, among respondents who said this fall had had an impact, 36% reported that transportation had increased; 14% that deliveries had been more frequent; 7% that inventory or warehousing had decreased; while 43% identified various other logistics and supply chain activities being affected. Of the respondents that ticked 'other impacts' to this question, examples of impacts cited included:

- Senior Manager of a 4PL provider: 'Higher usage of airfreight.'
- CEO, Passenger transport company: 'Less demand for public travel, but more private travel, hence increased congestion.'
- Senior Manager, 3PL provider: 'Changed customer priorities.'
- Senior Manager, 3PL provider: 'Reduced cost for operations.'

5.3. Expectation of the future price of oil, and expected impacts

Questions 7 to 9 focussed on the future price of oil, and asked respondents for:

- Question 7: Their expectations of this price at six future dates, see Table 1 below.
- Question 8: Their reasons underlying these price expectations.
- Question 9: How respondents envisaged their predicted oil prices would impact future logistics and SC activity.

	Length of time	*<$30/bbl*	*Not much change*	*$40-60/bbl*	*$60-90/bbl*	*$90-120/bbl*	*>$120/bbl*
a	3 months	22.7% (5)	63.6% (14)	13.6% (3)			
b	6 months	23.8% (5)	28.6% (6)	47.6% (10)			
c	1 Year	9.5% (2)	38.1% (8)	42.9% (9)	4.8% (1)	4.8% (1)	
d	2 years	10% (2)	10% (2)	40% (8)	30% (6)	5% (1)	5% (1)
f	5 years	20% (4)		20% (4)	30% (6)	20% (4)	10% (2)
g	10 years	22.7% (5)		13.6% (3)	27.3% (6)	9.1% (2)	27.3% (6)

Table 1: Respondent expectations of oil price in the coming months/years

Percentages: Calculated excluding missing values; *Data in brackets*: Number of responses in category (i.e. response frequency)

On the expected level of oil price (Question 7), the results were interesting. While the estimates varied considerably, the general trends (as summarized in Table 1) appeared to be:

- The oil price was expected to change little in the three months following the date of survey.
- Then to be lower, the same, or more probably a little bit higher, in six months.
- To generally trend higher (into the $40-$60, and $60-$90/bbl price brackets) in one and two years.

But beyond two years, opinions diverged significantly, as follows:

- By 5 years half the respondents saw the likely price to be in this higher $40-$90/bbl range; with 40% seeing the price as lower, and 10% as higher still (>$90/bbl).
- By 10 years, this split in opinion was even stronger: nearly a quarter saw the price as likely to be very low (<$30/bbl), while just over a quarter saw the price as likely to be >$120/bbl. Of the remaining 50%, the majority of these saw the price in a decade's time as being in the $60-$90/bbl range, i.e., to be lower than the price for most of the period 2007 to 2014.

In Question 8 respondents elaborated the thinking behind their choices of future oil price given in Question 7. Examples of such comments are as follows (where here each respondent's view of oil price 10 years hence is given first, to set their comment into context):

- <$30/bbl: Academic, Senior Manager: 'More and more new energy sources will be introduced.'
- <$30/bbl: Academic, Faculty: 'Today's oil price is the same as 13 years ago.'
- $60- $90/bbl: Academic, Professor and Head of Dept.: 'More production of oil expected over the next few years and beyond; plus alternative energy sources are being developed and getting less expensive.'
- $60-$90/bbl: Chartered Institute of Logistics and Transport, Senior position: 'Over-production in the present situation. When the oil price increases shale oil will be extensively produced.'
- >$120/bbl: CEO, Consultancy: 'Iranian production will reduce price in the short term - but scarcity will drive price up in the long term.'
- >$120/bbl: Academic, Deputy Director of School: 'Oil is still an essential commodity. Alternative energy sources are still limited and expensive. Oil will become more of a scarce resource.'

These views help explain the wide range of oil price estimates in Table 1; where a low price 10 years' hence, of <$30/bbl, follows logically for example from the view that: 'More and more new energy sources will be introduced; while a high price estimate 10 years' hence, of >$120/bbl, also follows logically enough from the view that: ' … Oil will become more of a scarce resource.' The work of the professional oil forecasters therefore must be to provide narrower price estimates than these, and to communicate these to the logistics and SC practitioners, so that forward decisions – which often incur very large investments - can be taken as rationally as possible.

Question 9 then asked: '*Based on the oil price trend you indicate above* [in Question 7]*, state briefly how you see this affecting future logistics and supply chain activities*?' Sample answers here included (with again the respondent's oil price estimate 10 years' hence given to set the reply into context):

- $60-$90/bbl. Senior Manager, 3PL provider: '[The current low price] buys a window for change in competitive markets (e.g. airlines).'
- $60-$90/bbl. Project Manager, train operator. 'Not my specialism, but the market will bear costs as it did before.'
- $60-$90/bbl. Academic, Professor and Head of Dept.: 'In the long term, inexpensive energy sources are important for continuous economic development, and oil is just one of many energy sources'.
- >$120/bbl. Academic, Head of Dept.: 'Tighter revenue margins; need for higher efficiencies; some government level push for innovative technologies becoming mainstream.'
- >$120/bbl. CEO, Passenger transport: 'Reduced cost and more activity in the short term; increased costs and a greater squeeze on efficiencies in the long term.'
- >$120/bbl. Academic, Deputy Director of School. 'Will require supply chains to be more efficient and effective.'
- >$120/bbl: CEO, Consultancy: 'It will reinforce environmental impact – give rise to more efficient trucks, routing.'

Here also the replies generally matched price expectations. Noticeably, no-one implied that the oil price might go high enough to reduce activity.

5.4. Overall comments

The final question, Question 10, asked respondents for their overall comments of the impact of changing oil price on logistics & SC activities. Replies here were often similar to those given earlier, so are not repeated. Of note were:

- $60-$90/bbl. Academic, Professor and Dept. Head: 'In the short term, oil price could affect the supply chain activities, though in the long term, oil is just one of many resources that affect the economic activities.'
- >$120/bbl. Academic, Head of Dept.: 'Higher costs gives: impact on manufacturing quality; drive for efficiency solutions; and a turn to localisation of several production activities.'

6. Conclusions

This research used the 'key informant' approach (see the methodology section), and as such the results are judged reliable and useful. It is recognised, however, that the research could have benefited from a larger number of respondents, and from more events and conferences being represented. In fact this is not as easy as it might seem, as the surveys were carried out at a particularly low point in the recent trajectory of oil price (at around $35/bbl), and at a time where the expectation from a range of commentators was for the price to go lower still; with $20/bbl and even less being mentioned. By contrast, currently (June 2016) the price has climbed back to $50/bbl, and there is far less talk of lower prices. Thus the three surveys reported above were carried out at a particularly useful price point in terms of understanding the viewpoints of practitioners and academics. Nevertheless, it is the intention that follow-on surveys will be carried out in future.

The main conclusions from this study are as follows:

- About half of respondents thought that the recent fall in oil price (from >$80/bbl for most of the period 2007 to 2014, down to $35/bbl at the dates of the surveys) had had no significant impact on logistics and SC activities. By contrast, the other half of respondents judged this impact to have been 'medium'; and where the nature of these impacts were identified (see Section 5.2).
- A wide range of expectations emerged from this study of the future price of oil, from both senior practitioners and educators; with the estimates for the oil price 10 years hence ranging from below $30/bbl to over $120/bbl.
- Explanations for this wide price range were generally logical. Those that foresaw a low price thought that new energy sources were expected to come on-stream significantly over this timeframe, while those that foresaw much higher prices held the view that these new sources were not likely to be especially significant, coupled with a view that oil supply itself was likely to be constrained.
- An important finding in this context were the proportions of respondents that supported the various views of future oil price. Nearly a quarter saw the price in a decade's time as likely to be very low (<$30/bbl); while the majority saw this price as being in the $60-$90/bbl range, *i.e., lower than that for most of the period 2007 to 2014.* Only a quarter of respondents thought the oil price likely to be >$120/bbl.
- In terms of likely impact of these anticipated oil prices on logistics and supply chain activities, respondents' views matched their views on price, with an expectation of a high price leading to a range of efficiency and similar measures being envisaged; see Section 5.3. It was noticeable however, that no-one saw the oil price as going high enough to reduce logistics and supply chain activity overall.

To set the above expectations of practitioners and educators of future oil prices into context, we note that virtually all current oil forecasts, from organisations such as the IEA, the US EIA, the oil majors and consultancies, see the global supply of *conventional oil* as being increasingly constrained from now on, with the result that most of any additional 'liquids' global supply that is required in future must come from the intrinsically expensive non-conventional oils, or from 'other liquids', such as coal-to-liquids or biofuels.

The results of the research reported in this paper suggest that the likelihood of such constraints seem not yet to be in the thinking of most of those working, or teaching, in logistics and supply chains. It is hoped therefore that this survey, combined with the other information set out here, can help inform both industry and academia of this aspect. In particular, this research may contribute towards the planning that will be required within companies for the medium-term oil supply challenges they may face in their logistics and supply chain activities.

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